ENERGY AND LIFE PROCESSES
Pre-AP Seventh Grade Science
2011-2012

Description

The sun is the center of our solar system. Without the sun, our solar system would not exist. Earth is unique among all planets in the solar system. Its distance from the sun ensures that temperature conditions on Earth will support life. Earth has an atmosphere and water which are also characteristics of a planet that will support life. Ecosystems on Earth consist of all the living (biotic) and nonliving (abiotic) components in a specific area. Recycling of biotic and abiotic materials in processes such as the water cycle, carbon cycle, and nitrogen cycle ensure that nutrients necessary to support life are continually available. Energy from the sun is used by autotrophs to produce food through the process of photosynthesis. Heterotrophs are all directly or indirectly reliant on these producers for survival either because they are herbivores, or consumers that eat herbivores or consumers of herbivores. Producers comprise the first trophic level in an ecosystem's energy pyramid. Ten percent of the energy available at this first trophic level is passed on to first-order consumers at the next trophic level. Second- and third-order consumers comprise the last two trophic levels of the energy pyramid. At each level, only ten percent of the energy available at the previous level is passed on. Other energy is transformed to support life processes of the organisms (e.g., digestion, growth, temperature regulation) or otherwise changed during natural events (e.g., decomposition). Energy transfer in an ecosystem can be graphically represented using food webs; food webs are multiple interconnected food chains. Emphasis is on investigation and prediction of plant responses to different environments, and accurate and precise measurements relating to those responses. Also emphasized is tracing the flow of energy through an ecosystem using graphic representations.

Connections

Energy from the sun is what makes Earth unique in its ability to support life. Energy cannot be created or destroyed, only transformed or transferred. Energy of motion is discussed in a previous unit. Energy and its use for life processes will be discussed in relationship to chemical processes that occur within human body systems in a later unit. Adaptations of organisms make them especially well-suited for life in specific ecosystems, and are discussed in a previous unit.

Enduring Understandings

1. Earth is the only planet in our solar system with characteristics necessary to support life. These characteristics include water, an atmosphere, and optimal distance from the Sun. Space flight requires accommodations in order to provide life support in the form of oxygen, removal of carbon dioxide, water, and a source of food.
2. Energy from the Sun is the basis for life on Earth.
3. Ecosystems are comprised all biotic and abiotic factors in an area and the interactions between them.
4. Energy is constantly cycled through an ecosystem.
5. Energy pyramids illustrate distribution of energy within an ecosystem.
6. Food webs illustrate transfer of energy within an ecosystem.
7. The water, carbon, and nitrogen cycles are responsible for the recycling of biotic (living) and abiotic (nonliving) components of an ecosystem.
8. Autotrophs (producers) make their own food using water, carbon dioxide, and energy from the sun in a process called photosynthesis.

9. Heterotrophs (consumers) obtain their food by eating producers, other consumers, or both.
10. Plants are producers (autotrophs), and producers are the foundation of all energy pyramids and food webs.
11. Stimuli in the environment can affect a plant's behavioral and physiological responses.
12. Decomposers play an important role in the recycling of nutrients in an ecosystem.
13. Organisms at different trophic levels within an ecosystem differ in the amounts of energy required for survival.

Essential Questions

1. Why is exploration of our solar system possible?
2. What features of our solar system make it possible for Earth to sustain life?
3. How does energy from the Sun support life?
4. What factors comprise an ecosystem?
5. How is energy transferred within an ecosystem?
6. How is energy transformed at each trophic level of an ecosystem?
7. How are nutrients recycled in an ecosystem?
8. What role do producers, consumers, and decomposers play in an ecosystem?
9. What is photosynthesis and how is it related to energy transfer in an ecosystem?
10. How do plants respond to environmental stimuli such as presence or absence of sunlight?

Essential Concepts and Skills

By the end of the unit, the student is expected to:

1. identify characteristics of our solar system that make space exploration possible
2. analyze the importance of the Sun to Earth's ability to sustain life
3. formulate a list of Earth's characteristics that make life possible
4. evaluate the efficiency of energy transfer within an ecosystem
5. produce a food web given information about organisms in an ecosystem
6. compare and contrast the limitations of food web diagrams to an actual ecosystem
7. create diagrams to show the recycling of water, carbon and nitrogen in an ecosystem
8. predict and justify what would happen to an ecosystem if all the decomposers became extinct
9. create an energy pyramid showing organisms present at each trophic level
10. calculate energy transferred from one trophic level to the next
11. construct a diagram to show how photosynthesis transforms water, carbon dioxide and energy from the Sun into usable food
12. predict a plant's response to changes in its environment
13. observe and measure changes in a plant's response to changes in its environment with accuracy and precision
14. construct graphs and/or tables of data for plants grown in different conditions
15. calculate average change, rate of change, range, and measurement error in order to analyze data collected about plant responses
16. hypothesize what would happen to plant growth under circumstances with varying energy input

What do students typically have as misconceptions?

1. Stronger organisms have more energy.
2. There are more herbivores because they have more offspring.
3. A species high on the food web is a predator to everything below it.

4. Energy accumulates in an ecosystem so that a top predator has all the energy from the organisms below it.
5. Carnivores can exist in a plant free world if their prey reproduce enough.

Preconception Survey

1. What happens to energy from the sun once it reaches Earth?
2. What relationship is there between sunlight, plants and animals?
3. What happens to energy once an organism dies?

Formative Assessment Items

1. Plan a trip to Mars taking into account the length of the trip, life essentials and recycling of waste.
2. Simulate predator/prey relationships and analyze the relationships between population sizes.
3. Use a Venn diagram to compare and contrast food web diagrams and energy pyramids.
4. Trace the existence of a water molecule, carbon atom, and/or nitrogen compound through its entire cycle.
5. Investigate the growth of plants under varying conditions and deduce reasons for plant responses.
6. Based on daily caloric needs, estimate how many producers it would take to support 100 heads of cattle.
7. Research climates, weather patterns, and patterns of energy received by the sun, and design a garden that would thrive at various locations north and south of the equator.

TEKS Covered

7.5 Matter and energy. The student knows that interactions occur between matter and energy. The student is expected to:

A) recognize that radiant energy from the Sun is transformed into chemical energy through the process of photosynthesis.

B) demonstrate and explain the cycling of matter within living systems such as in the decay of biomass in a compost bin.

C) diagram the flow of energy through living systems, including food chains, food webs, and energy pyramids. ***Supporting Standard-Category 1***

7.9 Earth and space. The student knows components of our solar system. The student is expected to:

A) analyze the characteristics of objects in our solar system that allow life to exist such as the proximity of the Sun, presence of water, and composition of the atmosphere.

B) identify the accommodations, considering the characteristics of our solar system that enabled manned space exploration.

6.11 Earth and space. The student understands the organization of our solar system and the relationships among the various bodies that comprise it. The student is expected to:

B) understand that gravity is the force that governs the motion of our solar system. ***Supporting Standard-Category 3***

College Board Standards Covered

LSM-PE.3.2.4 Construct a food web diagram, based on observations of or information on feeding relationships among specific organisms, to describe the feeding relationships among organisms. Identify assumptions made about the feeding relationships, and identify ways in which the food web diagram differs from the actual ecosystem interrelationships.

LSM-PE.4.1.1 Create a representation to describe the cycling of a carbon atom from the physical (abiotic) environment through the molecules of the biological (biotic) components of an ecosystem back to the physical (abiotic) environment.

*[**BOUNDARY:** The chemical structure of any of the molecules is not appropriate.]*

LSM-PE.4.1.2 Make and justify a claim concerning whether a particular molecule of oxygen inhaled today could be made of the same atoms of oxygen inhaled by someone a hundred years ago. Make and justify a claim concerning whether a particular molecule of water consumed today could be made of the same atoms of hydrogen and oxygen consumed by someone a hundred years ago.

LSM-PE.4.1.3 Predict and justify what might happen to an ecosystem if there were no bacteria or fungi present. Prediction and justification are based on ideas about matter recycling between the biological (biotic) and physical (abiotic) parts of an ecosystem

LSM-PE.4.2.1 Give examples and classify organisms as producers, consumers or decomposers based on their source of energy for growth and development.

LSM-PE.4.2.2 Describe, using a representation, the transfer of energy through an ecosystem. Representation includes the Sun, producers, consumers, decomposers and the transformation of chemical energy to thermal energy at each trophic level of an ecosystem.

LSM-PE.4.2.3 Predict which trophic level, or levels, in any given ecosystem will have the greatest number of organisms, and which will have the least. Justifications are based on ideas about energy transfers in ecosystems.

LSM-PE.4.2.4 Investigate the relationship between energy from the Sun and plant growth and health.

LSM-PE.4.2.4a Formulate a scientific question about the relationship between energy from the Sun and plant growth and health (e.g., number of leaves, number of flowers, color of leaves).

LSM-PE.4.2.4b Gather and record data, using tools to improve **accuracy** and **precision** of measurements, and complete multiple trials or use class data, for plants grown in varying conditions (e.g., light intensity, duration).

LSM-PE.4.2.4c Construct graphs and/or tables of data for plants grown in the different variable conditions.

LSM-PE.4.2.4d Calculate average change, rate of change, spread of data (i.e., range) and measurement error in order to analyze data, and describe the data in terms of the accuracy and precision of the data.

LSM-PE.4.2.4e Make a claim about the relationship between plant growth and health and energy from the Sun. Justification is based on collected evidence and on the understanding of photosynthesis and the cycling of matter.

Vocabulary

biotic, abiotic, producers, consumers, decomposers, photosynthesis, trophic levels, food chain, food web, energy pyramid, first-order consumer, second – and third level consumers, carnivore, herbivore, omnivore, predator, prey, biomass, water cycle, carbon cycle, nitrogen cycle, autotrophs, heterotrophs